

Evolutionary Algorithms 101

NicApicella

GPN II

24/Jun/2011

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Pros and Cons

- + computational complexity is 'irrelevant'
 - huge space (TSP)
 - many variables ("Curse of dimensionality")
- no distinction of geno-/phenotype
- no embryogenesis / nurture
- stopping criteria?
 - how good / far along are we?
 - why are we here? how did we get here?
 - local optima
- no guarantees on optimal (or even near-optimal) solution
- + adaptation to (changing) environment
- "no free lunch (in search & optimization)"

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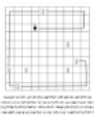
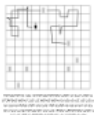
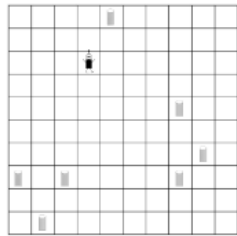
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Evolution

- Natural Selection
- Genetic drift
- Mutation
- Gene flow



Robby

10x10 environment

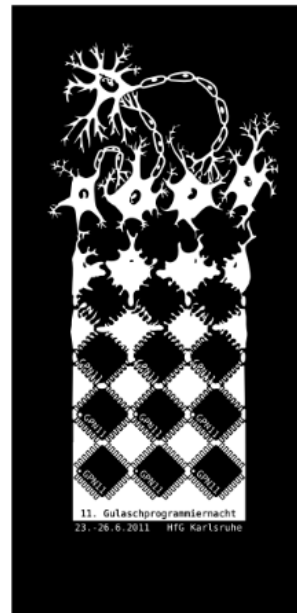
- walls all around
- each cell 50% chance of a can

Fitness function

- hit a wall: -5
- pick up nothing: -1
- pick up trash: +10

Trash-picking robot

- limited vision
- go N, S, E, W
- don't move
- pick up
- random move



Computer Science

Artificial Intelligence

Evolutionary Computation

Genetic Algorithm

0. Generate initial population
1. Perform selection (according to fitness function)
2. Reproduce (by applying genetic operators)
 - Crossover (recombination)
 - Mutation
3. GOTO 1

Evolution

- Natural Selection
"Survival of the Fittest"
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Evolution

Natural Selection

"Survival of the Fittest"

Genetic drift

Computer Science

Artificial Intelligence

Evolutionary Computation

Evolutionary Algorithms

Genetic Algorithms
Covariance Matrix Adaptation
Evolutionary Programming
Evolutionary Multi-Programming
Evolutionary Strategy
Differential Evolution

Swarm Intelligence

Ant Colony Optimization
Particle Swarm Optimization
Bee Algorithms

other population-based
metaheuristic methods

QUIET SC

Artificial Intelligence

Evolutionary Computation

Evolutionary Algorithms

- Genetic Algorithms
- Genetic Programming
- Evolutionary Programming
- Evolution Strategy
- Neuroevolution

Swarm Intelligence

- Ant Colony Optimization
- Particle Swarm Optimization
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other population-based
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Evolutionary Computation

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Genetic Algorithms
Genetic Programming
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Evolution Strategy
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Evolutionary Algorithms

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Robby

Trash-picking robot

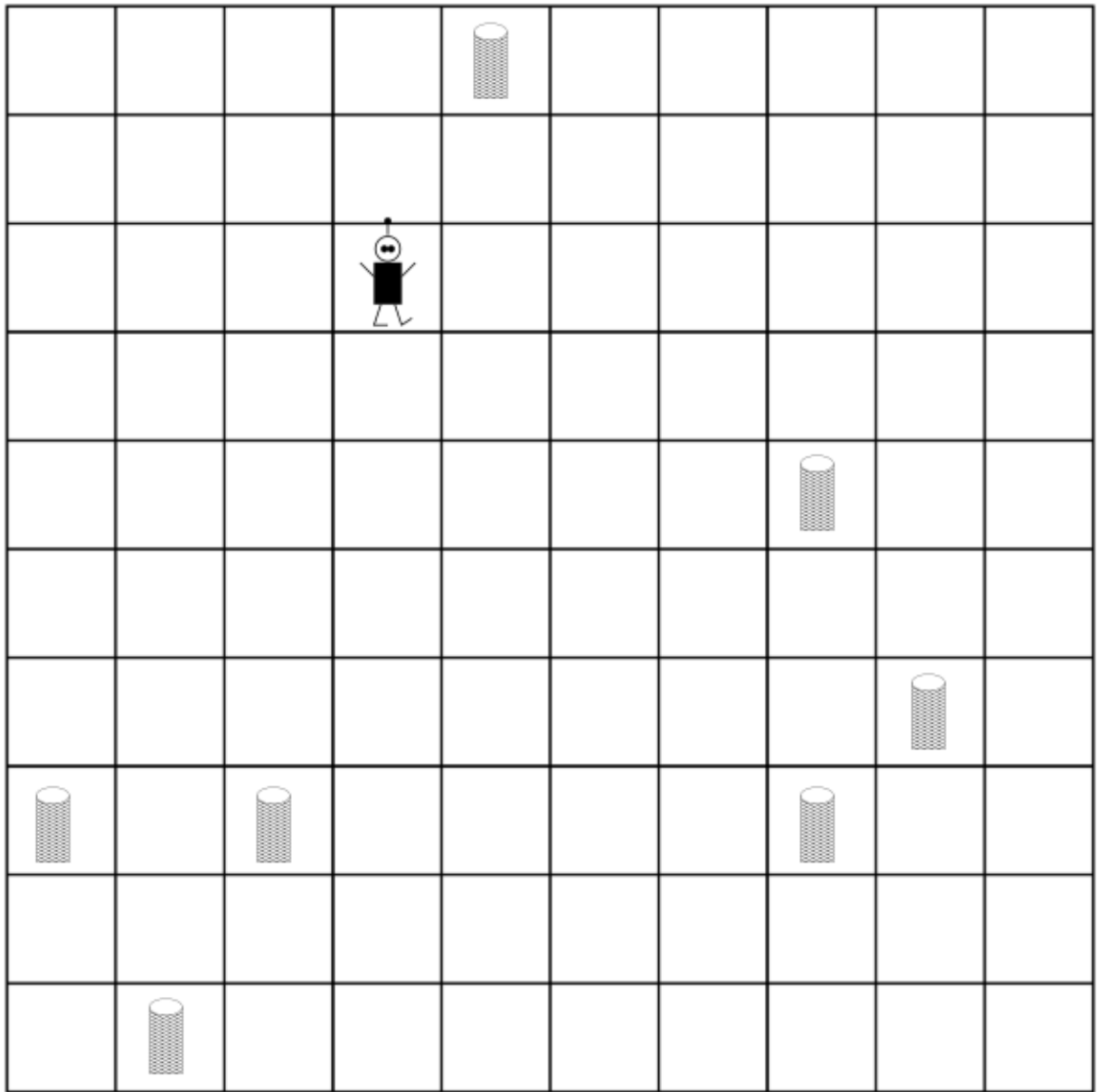
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...so, how do I make this "genetic"?

Candidate solution: "behaviour" of a Robby:

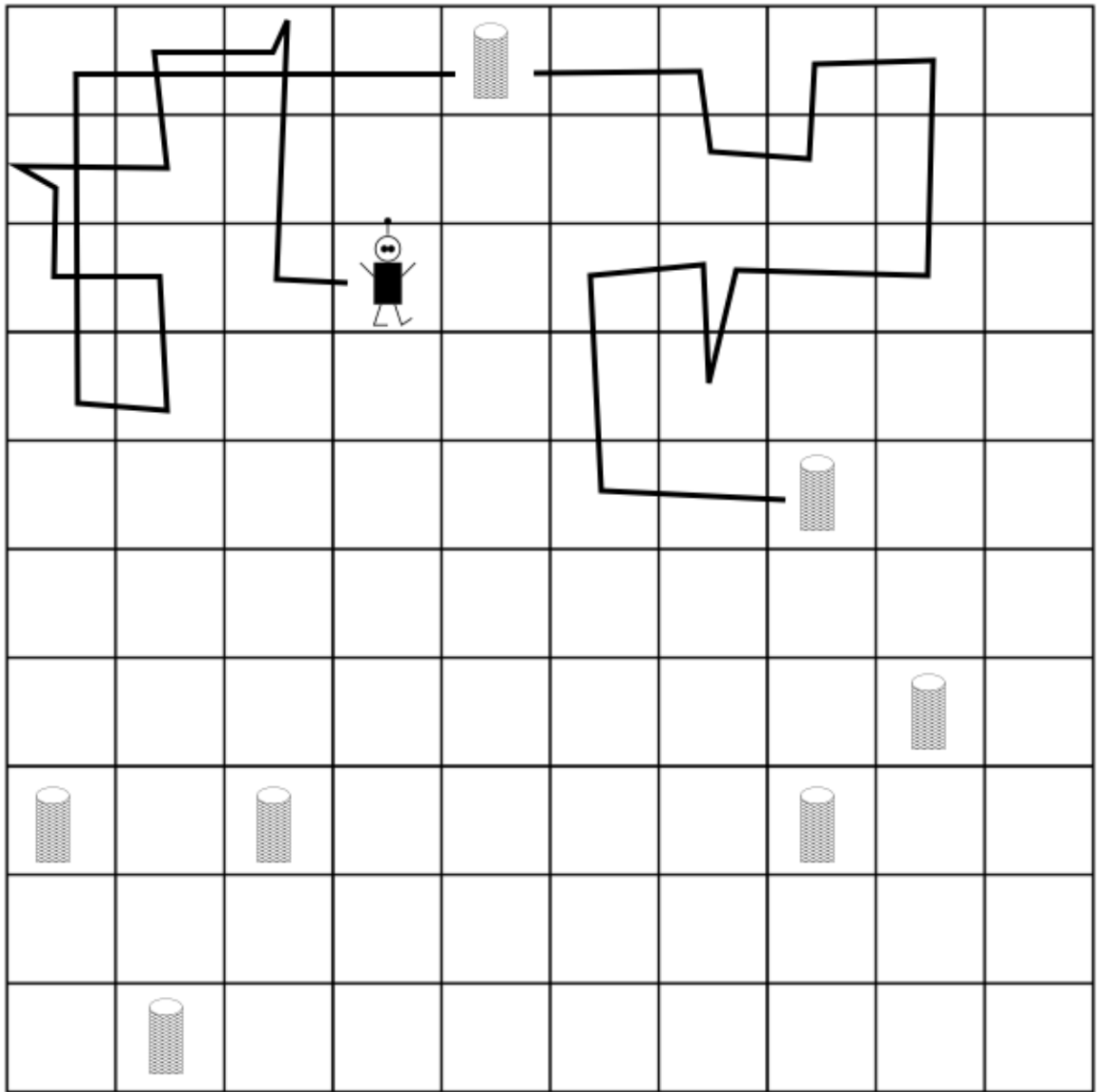
for each possible state, ...

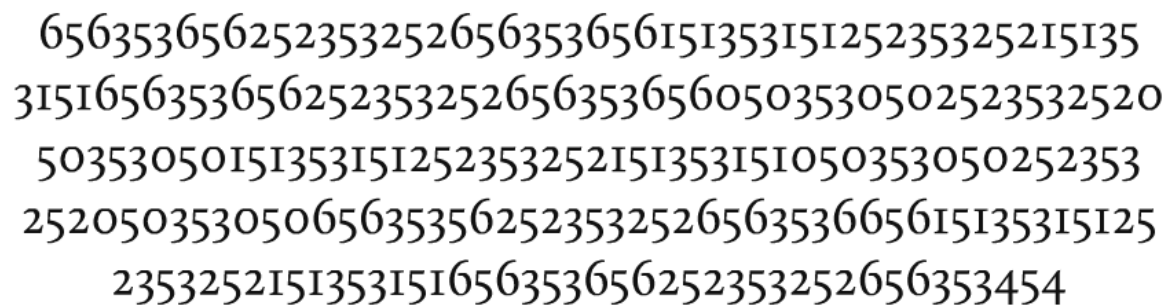
($3^5 = 243$ states, as defined by cell-status & robbys vision)

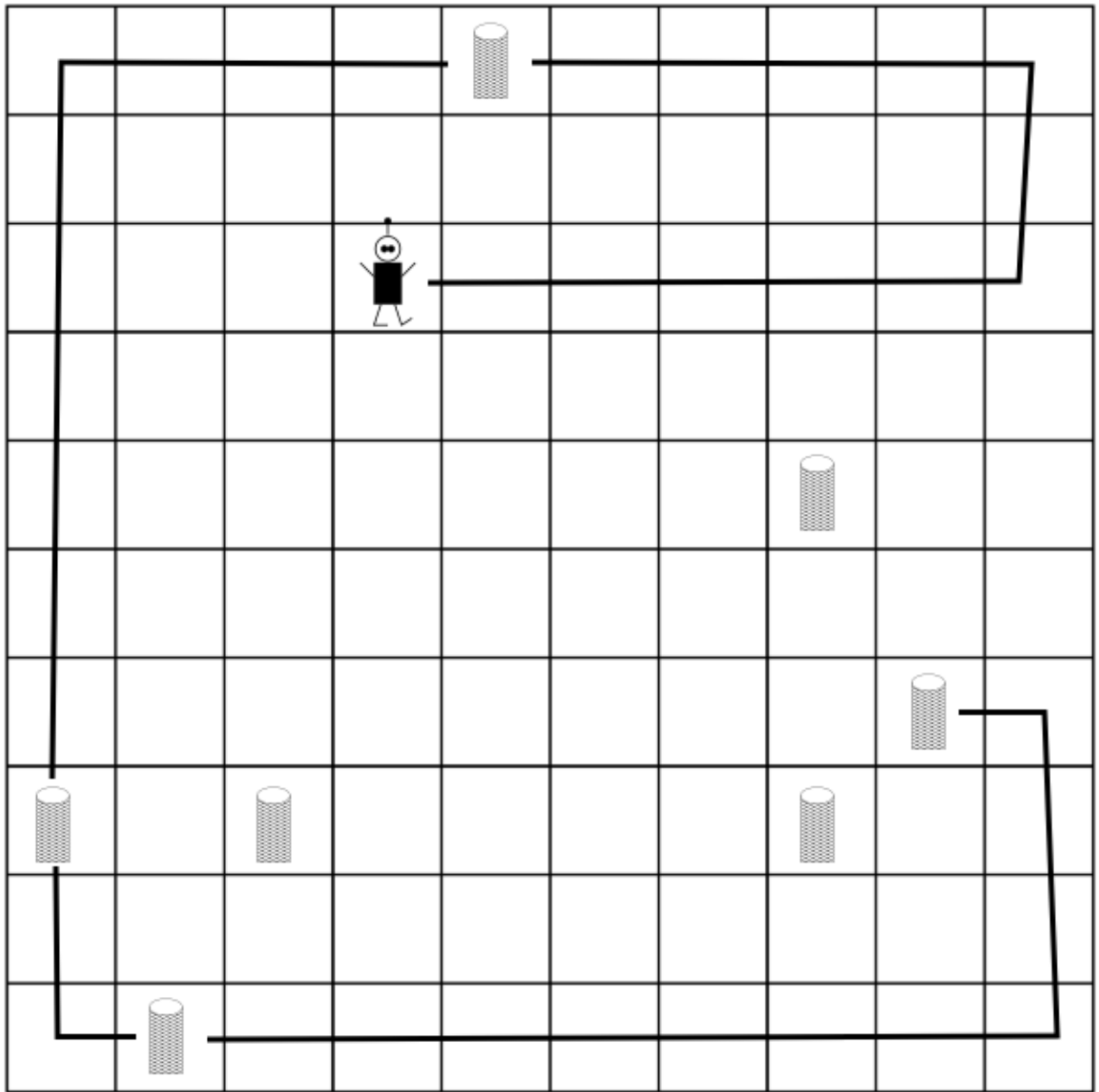
... execute one action

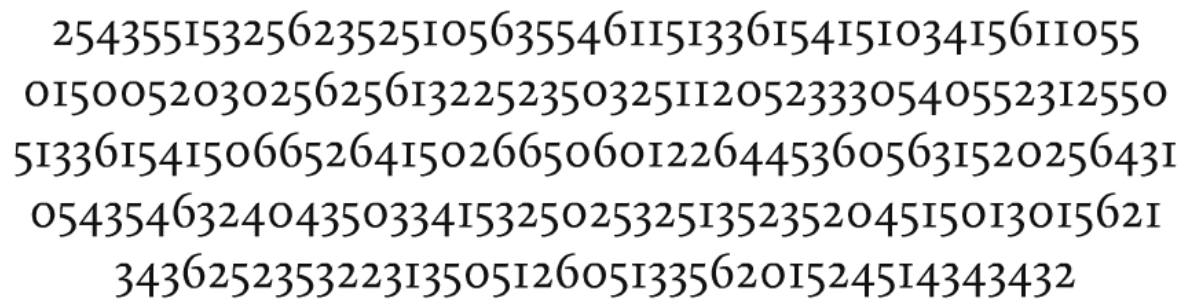
(one of 7)

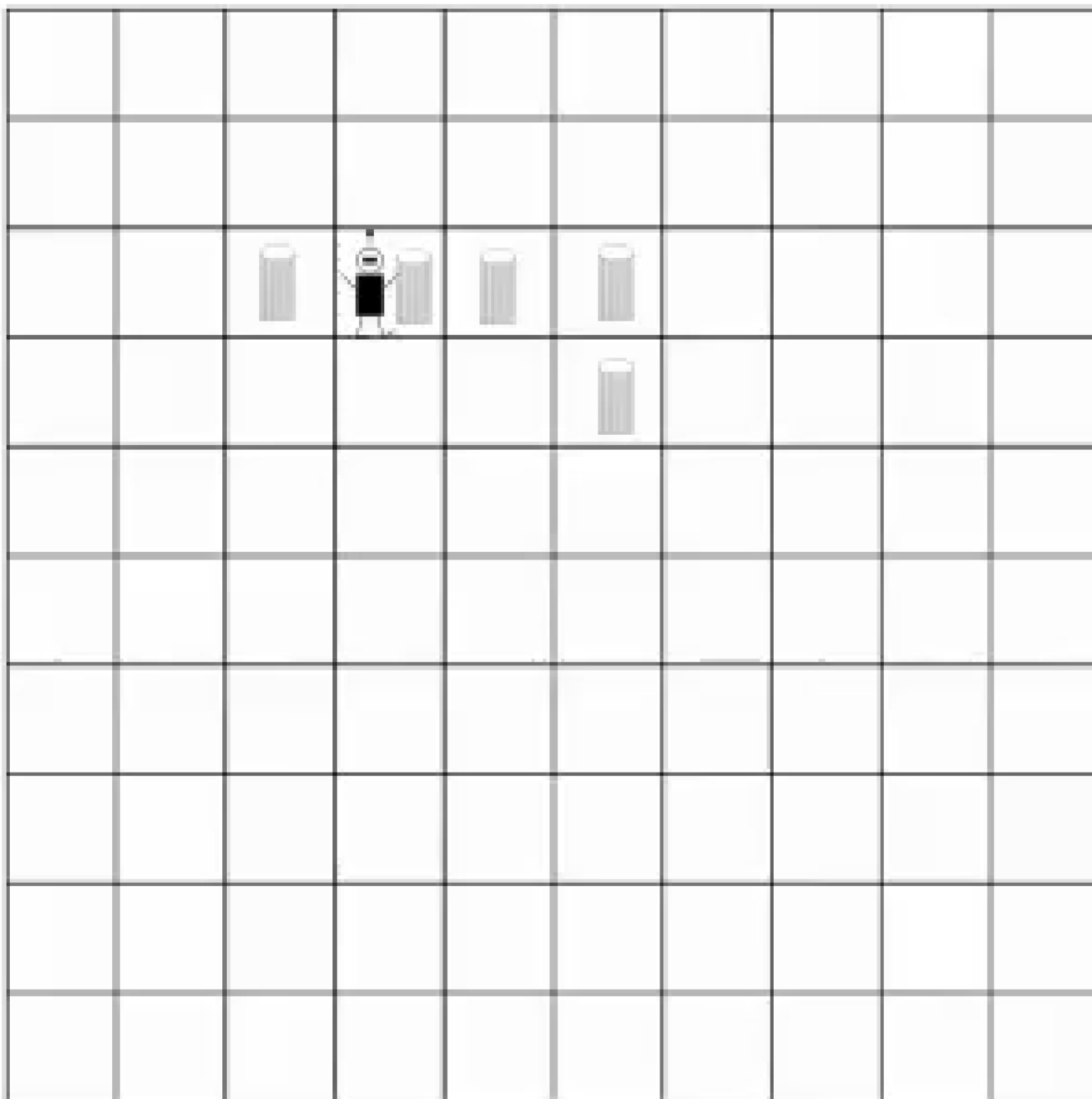
=> a "strategy" (or DNA) is a 243-long string of numbers 0..6

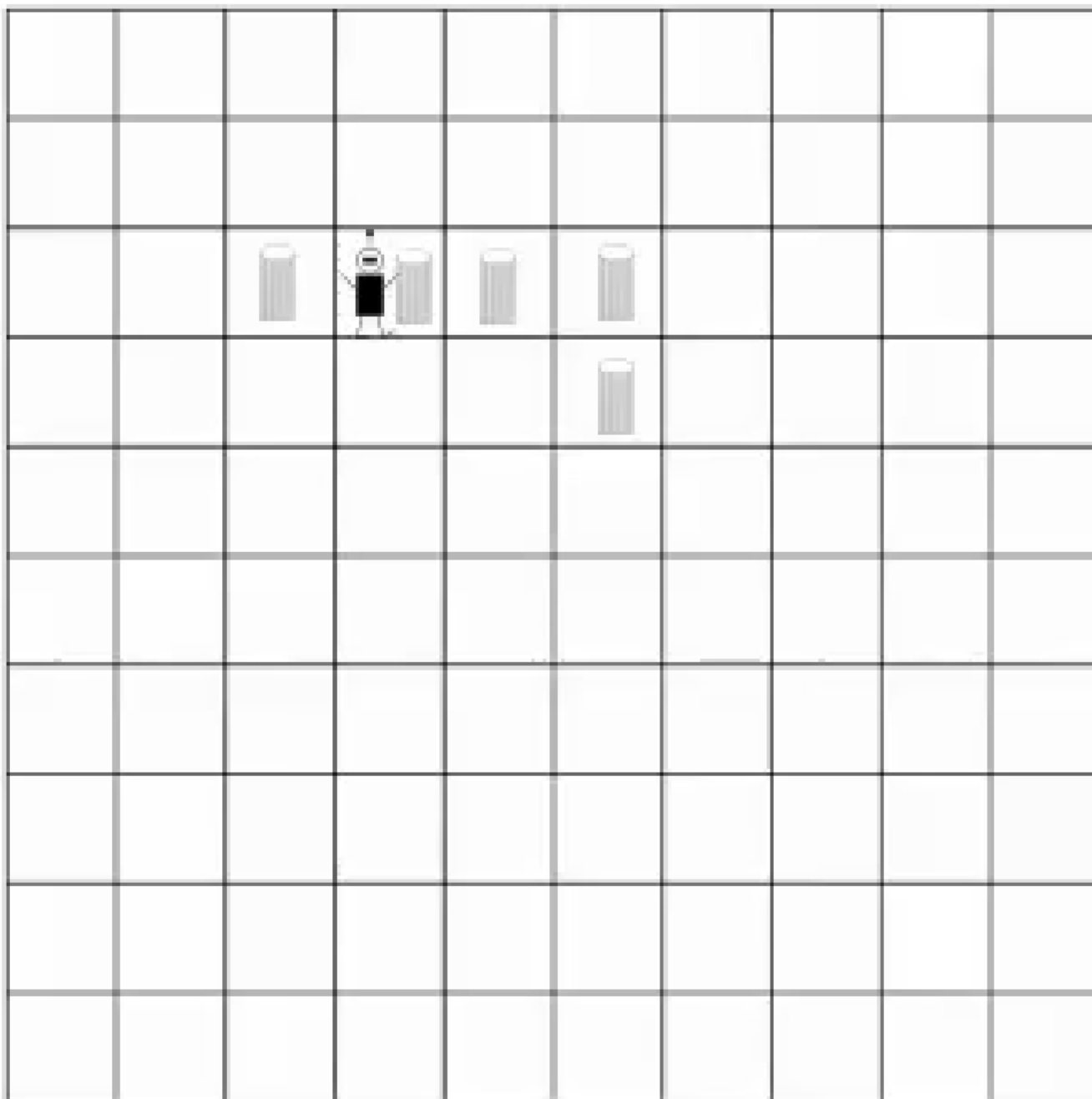












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Thank You!



Questions?